3D

```
> A<-rep(c(rep(c(-1),times=8),rep(c(1),times=8)),times=32)
> B<-rep(rep(c(rep(c(-1),times=4),rep(c(1),times=4)),times=2),times=32)
> C<-rep(rep(rep(c(-1,-1,1,1),times=2),times=2),times=32)
> D<-rep(rep(rep(c(-1,1),times=4),times=2),times=32)
> level.design<-data.frame(A=factor(A),B=factor(B),C=factor(C),D=factor(D))
> level.design
```

	A	B	C	D
1	-1	-1	-1	-1
2	-1	-1	-1	1
3	-1	-1	1	-1
4	-1	-1	1	1
5	-1	1	-1	-1
6	-1	1	-1	1
7	-1	1	1	-1
8	-1	1	1	1
9	1	-1	-1	-1
10	1	-1	-1	1
11	1	-1	1	-1
12	1	-1	1	1
13	1	1	-1	-1
14	1	1	-1	1
15	1	1	1	-1
16	1	1	1	1
17	-1	-1	-1	-1
18	-1	-1	-1	1
19	-1	-1	1	-1
20	-1	-1	1	1
21	-1	1	-1	-1
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24	-1	1	1	1
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26	1	-1	-1	1
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28	1	-1	1	1
29	1	1	-1	-1
30	1	1	-1	1
31	1	1	1	-1
32	1	1	1	1
33	-1	-1	-1	-1
34	-1	-1	-1	1
35	-1	-1	1	-1
36	-1	-1	1	1

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477    1    1 -1 -1
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508    1 -1    1    1
509    1    1 -1 -1
510    1    1 -1    1
511    1    1    1 -1
512    1    1    1    1
> Percent.sugar<-rep(c(rep(c(6),times=8),rep(c(15),times=8)),times=32)
> Ratio.yoghurt<-rep(rep(c(rep(c(7.2),times=4),rep(c(36.5),times=4)),times=2),times=32)
> Percent.kiwi<-rep(rep(rep(c(8,8,15,15),times=2),times=2),times=32)
> Percent.water<-rep(rep(rep(c(13,34),times=4),times=2),times=32)
> R1<-c(5,7,6,7,6,3,6,6,8,7,7,8,2,2,6,4)
> R2<-c(3,7,5,6,4,4,7,7,1,3,4,4,4,8,8,2)
> R3<-c(7,8,7,8,6,6,4,8,7,8,7,8,5,7,8,5)
> R4<-c(7,8,7,8,6,6,4,8,7,8,7,8,5,7,8,5)
```

```
> R5<-c(8,9,5,6,5,7,6,5,8,7,7,7,5,7,5,5)
> R6<-c(7,6,7,6,5,5,6,5,4,7,7,6,5,5,5,5)
> R7<-c(8,9,8,8,8,9,8,8,8,9,8,7,7,8,8,8)
> R8<-c(9,9,7,4,7,3,1,2,9,9,9,7,1,4,4,1)
> R9<-c(6,7,6,7,3,4,3,4,6,6,6,7,3,5,4,4)
> R10<-c(7,7,6,4,4,4,4,3,5,6,4,4,3,6,5,4)
> R11<-c(7,9,9,8,3,4,5,5,9,8,8,8,3,6,5,3)
> R12<-c(7,8,3,8,2,7,4,8,4,6,8,6,6,3,6,2)
> R13<-c(8,6,7,7,4,6,5,5,7,7,8,7,5,7,4,5)
> R14<-c(7,2,3,4,1,7,1,5,6,3,6,4,1,2,5,1)
> R15<-c(6,5,6,5,5,2,5,7,6,6,6,5,4,3,6,6)
> R16<-c(9,8,9,9,9,9,8,7,9,9,8,8,9,9,9,7)
> R17<-c(7,2,5,3,7,8,2,8,7,6,3,9,7,8,6,8)
> R18<-c(7,8,7,4,4,3,1,2,4,9,6,7,2,7,5,2)
> R19<-c(7,8,7,8,5,6,4,8,7,8,3,7,3,7,4,6)
> R20<-c(6,7,5,5,5,6,2,3,7,7,5,7,6,6,4,5)
> R21<-c(8,8,6,3,3,4,4,3,8,6,5,5,4,5,5,3)
> R22<-c(7,7,7,8,3,8,6,5,6,7,5,5,2,8,4,5)
> R23<-c(9,8,3,8,3,6,9,5,9,7,8,7,9,7,6,9)
> R24<-c(8,7,6,6,4,4,7,5,8,7,8,4,4,6,4,4)
> R25<-c(5,7,6,6,3,3,3,3,7,6,4,7,3,3,3,2)
> R26<-c(8,8,8,5,7,4,4,6,7,8,4,6,6,7,8,6)
> R27<-c(7,9,6,7,7,8,6,8,6,7,7,8,7,9,7,6)
> R28<-c(7,7,7,7,4,6,4,6,8,7,6,8,5,4,4,4)
> R29<-c(4,8,5,6,4,3,4,3,7,5,6,4,2,5,3,3)
> R30<-c(5,4,3,5,7,3,6,4,4,6,4,7,6,7,6,6)
> R31<-c(6,8,7,5,5,4,2,4,7,8,5,7,4,4,3,4)
> R32<-c(8,9,9,8,6,6,3,6,9,9,8,8,4,8,7,2)
>response<-c(R1,R2,R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14,R15,R16,R17,R18,R19,R20,R21,
R22,R23,R24,R25,R26,R27,R28,R29,R30,R31,R32)
>design<-data.frame(Percent.sugar=factor(Percent.sugar),Ratio.yoghurt=factor(Ratio.yoghurt),Pe
rcent.kiwi=factor(Percent.kiwi),Percent.water=factor(Percent.water),response)
> design
```

	Percent.sugar	Ratio.yoghurt	Percent.kiwi	Percent.water	response
1	6	7.2	8	13	5
2	6	7.2	8	34	7
3	6	7.2	15	13	6
4	6	7.2	15	34	7
5	6	36.5	8	13	6
6	6	36.5	8	34	3
7	6	36.5	15	13	6
8	6	36.5	15	34	6
9	15	7.2	8	13	8
10	15	7.2	8	34	7

11	15	7.2	15	13	7
12	15	7.2	15	34	8
13	15	36.5	8	13	2
14	15	36.5	8	34	2
15	15	36.5	15	13	6
16	15	36.5	15	34	4
17	6	7.2	8	13	3
18	6	7.2	8	34	7
19	6	7.2	15	13	5
20	6	7.2	15	34	6
21	6	36.5	8	13	4
22	6	36.5	8	34	4
23	6	36.5	15	13	7
24	6	36.5	15	34	7
25	15	7.2	8	13	1
26	15	7.2	8	34	3
27	15	7.2	15	13	4
28	15	7.2	15	34	4
29	15	36.5	8	13	4
30	15	36.5	8	34	8
31	15	36.5	15	13	8
32	15	36.5	15	34	2
33	6	7.2	8	13	7
34	6	7.2	8	34	8
35	6	7.2	15	13	7
36	6	7.2	15	34	8
37	6	36.5	8	13	6
38	6	36.5	8	34	6
39	6	36.5	15	13	4
40	6	36.5	15	34	8
41	15	7.2	8	13	7
42	15	7.2	8	34	8
43	15	7.2	15	13	7
44	15	7.2	15	34	8
45	15	36.5	8	13	5
46	15	36.5	8	34	7
47	15	36.5	15	13	8
48	15	36.5	15	34	5
49	6	7.2	8	13	7
50	6	7.2	8	34	8
51	6	7.2	15	13	7
52	6	7.2	15	34	8
53	6	36.5	8	13	6
54	6	36.5	8	34	6

55	6	36.5	15	13	4
56	6	36.5	15	34	8
57	15	7.2	8	13	7
58	15	7.2	8	34	8
59	15	7.2	15	13	7
60	15	7.2	15	34	8
61	15	36.5	8	13	5
62	15	36.5	8	34	7
63	15	36.5	15	13	8
64	15	36.5	15	34	5
65	6	7.2	8	13	8
66	6	7.2	8	34	9
67	6	7.2	15	13	5
68	6	7.2	15	34	6
69	6	36.5	8	13	5
70	6	36.5	8	34	7
71	6	36.5	15	13	6
72	6	36.5	15	34	5
73	15	7.2	8	13	8
74	15	7.2	8	34	7
75	15	7.2	15	13	7
76	15	7.2	15	34	7
77	15	36.5	8	13	5
78	15	36.5	8	34	7
79	15	36.5	15	13	5
80	15	36.5	15	34	5
81	6	7.2	8	13	7
82	6	7.2	8	34	6
83	6	7.2	15	13	7
84	6	7.2	15	34	6
85	6	36.5	8	13	5
86	6	36.5	8	34	5
87	6	36.5	15	13	6
88	6	36.5	15	34	5
89	15	7.2	8	13	4
90	15	7.2	8	34	7
91	15	7.2	15	13	7
92	15	7.2	15	34	6
93	15	36.5	8	13	5
94	15	36.5	8	34	5
95	15	36.5	15	13	5
96	15	36.5	15	34	5
97	6	7.2	8	13	8
98	6	7.2	8	34	9

99	6	7.2	15	13	8
100	6	7.2	15	34	8
101	6	36.5	8	13	8
102	6	36.5	8	34	9
103	6	36.5	15	13	8
104	6	36.5	15	34	8
105	15	7.2	8	13	8
106	15	7.2	8	34	9
107	15	7.2	15	13	8
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114	6	7.2	8	34	9
115	6	7.2	15	13	7
116	6	7.2	15	34	4
117	6	36.5	8	13	7
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119	6	36.5	15	13	1
120	6	36.5	15	34	2
121	15	7.2	8	13	9
122	15	7.2	8	34	9
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124	15	7.2	15	34	7
125	15	36.5	8	13	1
126	15	36.5	8	34	4
127	15	36.5	15	13	4
128	15	36.5	15	34	1
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132	6	7.2	15	34	7
133	6	36.5	8	13	3
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138	15	7.2	8	34	6
139	15	7.2	15	13	6
140	15	7.2	15	34	7
141	15	36.5	8	13	3
142	15	36.5	8	34	5

143	15	36.5	15	13	4
144	15	36.5	15	34	4
145	6	7.2	8	13	7
146	6	7.2	8	34	7
147	6	7.2	15	13	6
148	6	7.2	15	34	4
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156	15	7.2	15	34	4
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158	15	36.5	8	34	6
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160	15	36.5	15	34	4
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162	6	7.2	8	34	9
163	6	7.2	15	13	9
164	6	7.2	15	34	8
165	6	36.5	8	13	3
166	6	36.5	8	34	4
167	6	36.5	15	13	5
168	6	36.5	15	34	5
169	15	7.2	8	13	9
170	15	7.2	8	34	8
171	15	7.2	15	13	8
172	15	7.2	15	34	8
173	15	36.5	8	13	3
174	15	36.5	8	34	6
175	15	36.5	15	13	5
176	15	36.5	15	34	3
177	6	7.2	8	13	7
178	6	7.2	8	34	8
179	6	7.2	15	13	3
180	6	7.2	15	34	8
181	6	36.5	8	13	2
182	6	36.5	8	34	7
183	6	36.5	15	13	4
184	6	36.5	15	34	8
185	15	7.2	8	13	4
186	15	7.2	8	34	6

187	15	7.2	15	13	8
188	15	7.2	15	34	6
189	15	36.5	8	13	6
190	15	36.5	8	34	3
191	15	36.5	15	13	6
192	15	36.5	15	34	2
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197	6	36.5	8	13	4
198	6	36.5	8	34	6
199	6	36.5	15	13	5
200	6	36.5	15	34	5
201	15	7.2	8	13	7
202	15	7.2	8	34	7
203	15	7.2	15	13	8
204	15	7.2	15	34	7
205	15	36.5	8	13	5
206	15	36.5	8	34	7
207	15	36.5	15	13	4
208	15	36.5	15	34	5
209	6	7.2	8	13	7
210	6	7.2	8	34	2
211	6	7.2	15	13	3
212	6	7.2	15	34	4
213	6	36.5	8	13	1
214	6	36.5	8	34	7
215	6	36.5	15	13	1
216	6	36.5	15	34	5
217	15	7.2	8	13	6
218	15	7.2	8	34	3
219	15	7.2	15	13	6
220	15	7.2	15	34	4
221	15	36.5	8	13	1
222	15	36.5	8	34	2
223	15	36.5	15	13	5
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226	6	7.2	8	34	5
227	6	7.2	15	13	6
228	6	7.2	15	34	5
229	6	36.5	8	13	5
230	6	36.5	8	34	2

231	6	36.5	15	13	5
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233	15	7.2	8	13	6
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235	15	7.2	15	13	6
236	15	7.2	15	34	5
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256	15	36.5	15	34	7
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258	6	7.2	8	34	2
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263	6	36.5	15	13	2
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271	15	36.5	15	13	6
272	15	36.5	15	34	8
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275	6	7.2	15	13	7
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277	6	36.5	8	13	4
278	6	36.5	8	34	3
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280	6	36.5	15	34	2
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283	15	7.2	15	13	6
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285	15	36.5	8	13	2
286	15	36.5	8	34	7
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288	15	36.5	15	34	2
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307	6	7.2	15	13	5
308	6	7.2	15	34	5
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315	15	7.2	15	13	5
316	15	7.2	15	34	7
317	15	36.5	8	13	6
318	15	36.5	8	34	6

319	15	36.5	15	13	4
320	15	36.5	15	34	5
321	6	7.2	8	13	8
322	6	7.2	8	34	8
323	6	7.2	15	13	6
324	6	7.2	15	34	3
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326	6	36.5	8	34	4
327	6	36.5	15	13	4
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331	15	7.2	15	13	5
332	15	7.2	15	34	5
333	15	36.5	8	13	4
334	15	36.5	8	34	5
335	15	36.5	15	13	5
336	15	36.5	15	34	3
337	6	7.2	8	13	7
338	6	7.2	8	34	7
339	6	7.2	15	13	7
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341	6	36.5	8	13	3
342	6	36.5	8	34	8
343	6	36.5	15	13	6
344	6	36.5	15	34	5
345	15	7.2	8	13	6
346	15	7.2	8	34	7
347	15	7.2	15	13	5
348	15	7.2	15	34	5
349	15	36.5	8	13	2
350	15	36.5	8	34	8
351	15	36.5	15	13	4
352	15	36.5	15	34	5
353	6	7.2	8	13	9
354	6	7.2	8	34	8
355	6	7.2	15	13	3
356	6	7.2	15	34	8
357	6	36.5	8	13	3
358	6	36.5	8	34	6
359	6	36.5	15	13	9
360	6	36.5	15	34	5
361	15	7.2	8	13	9
362	15	7.2	8	34	7

363	15	7.2	15	13	8
364	15	7.2	15	34	7
365	15	36.5	8	13	9
366	15	36.5	8	34	7
367	15	36.5	15	13	6
368	15	36.5	15	34	9
369	6	7.2	8	13	8
370	6	7.2	8	34	7
371	6	7.2	15	13	6
372	6	7.2	15	34	6
373	6	36.5	8	13	4
374	6	36.5	8	34	4
375	6	36.5	15	13	7
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377	15	7.2	8	13	8
378	15	7.2	8	34	7
379	15	7.2	15	13	8
380	15	7.2	15	34	4
381	15	36.5	8	13	4
382	15	36.5	8	34	6
383	15	36.5	15	13	4
384	15	36.5	15	34	4
385	6	7.2	8	13	5
386	6	7.2	8	34	7
387	6	7.2	15	13	6
388	6	7.2	15	34	6
389	6	36.5	8	13	3
390	6	36.5	8	34	3
391	6	36.5	15	13	3
392	6	36.5	15	34	3
393	15	7.2	8	13	7
394	15	7.2	8	34	6
395	15	7.2	15	13	4
396	15	7.2	15	34	7
397	15	36.5	8	13	3
398	15	36.5	8	34	3
399	15	36.5	15	13	3
400	15	36.5	15	34	2
401	6	7.2	8	13	8
402	6	7.2	8	34	8
403	6	7.2	15	13	8
404	6	7.2	15	34	5
405	6	36.5	8	13	7
406	6	36.5	8	34	4

407	6	36.5	15	13	4
408	6	36.5	15	34	6
409	15	7.2	8	13	7
410	15	7.2	8	34	8
411	15	7.2	15	13	4
412	15	7.2	15	34	6
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414	15	36.5	8	34	7
415	15	36.5	15	13	8
416	15	36.5	15	34	6
417	6	7.2	8	13	7
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419	6	7.2	15	13	6
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421	6	36.5	8	13	7
422	6	36.5	8	34	8
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425	15	7.2	8	13	6
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431	15	36.5	15	13	7
432	15	36.5	15	34	6
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435	6	7.2	15	13	7
436	6	7.2	15	34	7
437	6	36.5	8	13	4
438	6	36.5	8	34	6
439	6	36.5	15	13	4
440	6	36.5	15	34	6
441	15	7.2	8	13	8
442	15	7.2	8	34	7
443	15	7.2	15	13	6
444	15	7.2	15	34	8
445	15	36.5	8	13	5
446	15	36.5	8	34	4
447	15	36.5	15	13	4
448	15	36.5	15	34	4
449	6	7.2	8	13	4
450	6	7.2	8	34	8

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453	6	36.5	8	13	4
454	6	36.5	8	34	3
455	6	36.5	15	13	4
456	6	36.5	15	34	3
457	15	7.2	8	13	7
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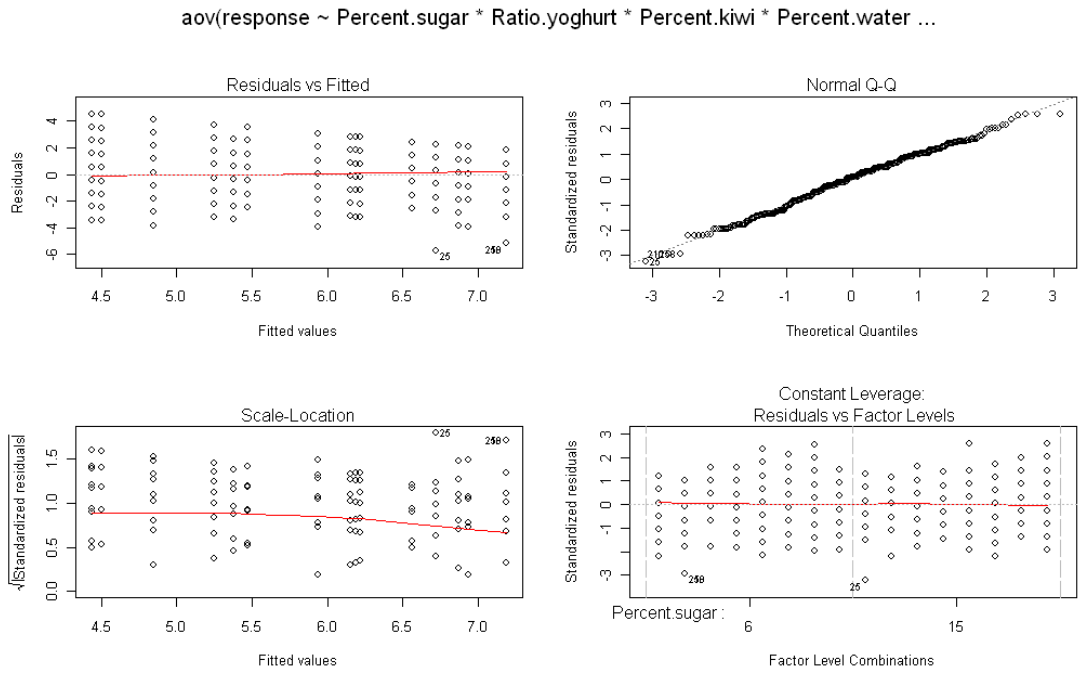
460	15	7.2	15	34	4
461	15	36.5	8	13	2
462	15	36.5	8	34	5
463	15	36.5	15	13	3
464	15	36.5	15	34	3
465	6	7.2	8	13	5
466	6	7.2	8	34	4
467	6	7.2	15	13	3
468	6	7.2	15	34	5
469	6	36.5	8	13	7
470	6	36.5	8	34	3
471	6	36.5	15	13	6
472	6	36.5	15	34	4
473	15	7.2	8	13	4
474	15	7.2	8	34	6
475	15	7.2	15	13	4
476	15	7.2	15	34	7
477	15	36.5	8	13	6
478	15	36.5	8	34	7
479	15	36.5	15	13	6
480	15	36.5	15	34	6
481	6	7.2	8	13	6
482	6	7.2	8	34	8
483	6	7.2	15	13	7
484	6	7.2	15	34	5
485	6	36.5	8	13	5
486	6	36.5	8	34	4
487	6	36.5	15	13	2
488	6	36.5	15	34	4
489	15	7.2	8	13	7
490	15	7.2	8	34	8
491	15	7.2	15	13	5
492	15	7.2	15	34	7
493	15	36.5	8	13	4
494	15	36.5	8	34	4

495	15	36.5	15	13	3
496	15	36.5	15	34	4
497	6	7.2	8	13	8
498	6	7.2	8	34	9
499	6	7.2	15	13	9
500	6	7.2	15	34	8
501	6	36.5	8	13	6
502	6	36.5	8	34	6
503	6	36.5	15	13	3
504	6	36.5	15	34	6
505	15	7.2	8	13	9
506	15	7.2	8	34	9
507	15	7.2	15	13	8
508	15	7.2	15	34	8
509	15	36.5	8	13	4
510	15	36.5	8	34	8
511	15	36.5	15	13	7
512	15	36.5	15	34	2

```
>design.aov<-aov(response~Percent.sugar*Ratio.yoghurt*Percent.kiwi*Percent.water,data=desig
n)
> summary(design.aov)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Percent.sugar	1	0.10	0.10	0.0296	0.863420	
Ratio.yoghurt	1	317.21	317.21	98.1821	< 2.2e-16	***
Percent.kiwi	1	21.53	21.53	6.6650	0.010118	*
Percent.water	1	14.78	14.78	4.5757	0.032915	*
Percent.sugar:Ratio.yoghurt	1	0.33	0.33	0.1022	0.749380	
Percent.sugar:Percent.kiwi	1	0.44	0.44			
Ratio.yoghurt:Percent.kiwi	1	7.27	7.27			
Percent.sugar:Percent.water	1	0.56	0.56			
Ratio.yoghurt:Percent.water	1	1.22	1.22			
Percent.kiwi:Percent.water	1	9.30	9.30			
Percent.sugar:Ratio.yoghurt:Percent.kiwi	1	1.88	1.88			
Percent.sugar:Ratio.yoghurt:Percent.water	1	2.39	2.39			
Percent.sugar:Percent.kiwi:Percent.water	1	12.81	12.81			
Ratio.yoghurt:Percent.kiwi:Percent.water	1	7.75	7.75			
Percent.sugar:Ratio.yoghurt:Percent.kiwi:Percent.water	1	24.06	24.06			
Residuals	496	1602.47	3.23			

```
Percent.sugar:Percent.kiwi                                  0.1360  0.712427
Ratio.yoghurt:Percent.kiwi                                  2.2495  0.134296
Percent.sugar:Percent.water                                 0.1747  0.676139
Ratio.yoghurt:Percent.water                                 0.3778  0.539046
Percent.kiwi:Percent.water                                  2.8782  0.090414 .
Percent.sugar:Ratio.yoghurt:Percent.kiwi                    0.5810  0.446299
Percent.sugar:Ratio.yoghurt:Percent.water                   0.7406  0.389898
Percent.sugar:Percent.kiwi:Percent.water                    3.9664  0.046966 *
Ratio.yoghurt:Percent.kiwi:Percent.water                    2.3994  0.122019
Percent.sugar:Ratio.yoghurt:Percent.kiwi:Percent.water      7.4485  0.006575 **
Residuals
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
> oldpar<-par(oma=c(0,0,3,0),mfrow=c(2,2))
> plot(design.aov)
> par(oldpar)
```




```
> library(rsm)
> design.rsm<-data.frame(Percent.sugar,Ratio.yoghurt,Percent.kiwi,Percent.water,response)
>design.CR<-coded.data(design.rsm,x1~(Percent.sugar-10.5)/4.5,x2~(Ratio.yoghurt-21.85)/14.65,
x3~(Percent.kiwi-11.5)/3.5,x4~(Percent.water-23.5)/10.5)
> design.CR
   x1 x2 x3 x4 response
1  -1 -1 -1 -1        5
2  -1 -1 -1  1        7
3  -1 -1  1 -1        6
4  -1 -1  1  1        7
```

5	-1	1	-1	-1	6
6	-1	1	-1	1	3
7	-1	1	1	-1	6
8	-1	1	1	1	6
9	1	-1	-1	-1	8
10	1	-1	-1	1	7
11	1	-1	1	-1	7
12	1	-1	1	1	8
13	1	1	-1	-1	2
14	1	1	-1	1	2
15	1	1	1	-1	6
16	1	1	1	1	4
17	-1	-1	-1	-1	3
18	-1	-1	-1	1	7
19	-1	-1	1	-1	5
20	-1	-1	1	1	6
21	-1	1	-1	-1	4
22	-1	1	-1	1	4
23	-1	1	1	-1	7
24	-1	1	1	1	7
25	1	-1	-1	-1	1
26	1	-1	-1	1	3
27	1	-1	1	-1	4
28	1	-1	1	1	4
29	1	1	-1	-1	4
30	1	1	-1	1	8
31	1	1	1	-1	8
32	1	1	1	1	2
33	-1	-1	-1	-1	7
34	-1	-1	-1	1	8
35	-1	-1	1	-1	7
36	-1	-1	1	1	8
37	-1	1	-1	-1	6
38	-1	1	-1	1	6
39	-1	1	1	-1	4
40	-1	1	1	1	8
41	1	-1	-1	-1	7
42	1	-1	-1	1	8
43	1	-1	1	-1	7
44	1	-1	1	1	8
45	1	1	-1	-1	5
46	1	1	-1	1	7
47	1	1	1	-1	8
48	1	1	1	1	5

49	-1	-1	-1	-1	7
50	-1	-1	-1	1	8
51	-1	-1	1	-1	7
52	-1	-1	1	1	8
53	-1	1	-1	-1	6
54	-1	1	-1	1	6
55	-1	1	1	-1	4
56	-1	1	1	1	8
57	1	-1	-1	-1	7
58	1	-1	-1	1	8
59	1	-1	1	-1	7
60	1	-1	1	1	8
61	1	1	-1	-1	5
62	1	1	-1	1	7
63	1	1	1	-1	8
64	1	1	1	1	5
65	-1	-1	-1	-1	8
66	-1	-1	-1	1	9
67	-1	-1	1	-1	5
68	-1	-1	1	1	6
69	-1	1	-1	-1	5
70	-1	1	-1	1	7
71	-1	1	1	-1	6
72	-1	1	1	1	5
73	1	-1	-1	-1	8
74	1	-1	-1	1	7
75	1	-1	1	-1	7
76	1	-1	1	1	7
77	1	1	-1	-1	5
78	1	1	-1	1	7
79	1	1	1	-1	5
80	1	1	1	1	5
81	-1	-1	-1	-1	7
82	-1	-1	-1	1	6
83	-1	-1	1	-1	7
84	-1	-1	1	1	6
85	-1	1	-1	-1	5
86	-1	1	-1	1	5
87	-1	1	1	-1	6
88	-1	1	1	1	5
89	1	-1	-1	-1	4
90	1	-1	-1	1	7
91	1	-1	1	-1	7
92	1	-1	1	1	6

93	1	1	-1	-1		5
94	1	1	-1	1		5
95	1	1	1	-1		5
96	1	1	1	1		5
97	-1	-1	-1	-1		8
98	-1	-1	-1	1		9
99	-1	-1	1	-1		8
100	-1	-1	1	1		8
101	-1	1	-1	-1		8
102	-1	1	-1	1		9
103	-1	1	1	-1		8
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106	1	-1	-1	1		9
107	1	-1	1	-1		8
108	1	-1	1	1		7
109	1	1	-1	-1		7
110	1	1	-1	1		8
111	1	1	1	-1		8
112	1	1	1	1		8
113	-1	-1	-1	-1		9
114	-1	-1	-1	1		9
115	-1	-1	1	-1		7
116	-1	-1	1	1		4
117	-1	1	-1	-1		7
118	-1	1	-1	1		3
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122	1	-1	-1	1		9
123	1	-1	1	-1		9
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125	1	1	-1	-1		1
126	1	1	-1	1		4
127	1	1	1	-1		4
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131	-1	-1	1	-1		6
132	-1	-1	1	1		7
133	-1	1	-1	-1		3
134	-1	1	-1	1		4
135	-1	1	1	-1		3
136	-1	1	1	1		4

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360	-1	1	1	1	5
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364	1	-1	1	1	7
365	1	1	-1	-1	9
366	1	1	-1	1	7
367	1	1	1	-1	6
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369	-1	-1	-1	-1	8
370	-1	-1	-1	1	7
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372	-1	-1	1	1	6
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374	-1	1	-1	1	4
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378	1	-1	-1	1	7
379	1	-1	1	-1	8
380	1	-1	1	1	4
381	1	1	-1	-1	4
382	1	1	-1	1	6
383	1	1	1	-1	4
384	1	1	1	1	4
385	-1	-1	-1	-1	5
386	-1	-1	-1	1	7
387	-1	-1	1	-1	6
388	-1	-1	1	1	6
389	-1	1	-1	-1	3
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391	-1	1	1	-1	3
392	-1	1	1	1	3
393	1	-1	-1	-1	7
394	1	-1	-1	1	6
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398	1	1	-1	1	3
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400	1	1	1	1	2

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487 -1 1 1 -1 2
488 -1 1 1 1 4

```
489    1 -1 -1 -1            7
490    1 -1 -1    1          8
491    1 -1    1 -1          5
492    1 -1    1    1        7
493    1    1 -1 -1          4
494    1    1 -1    1        4
495    1    1    1 -1        3
496    1    1    1    1        4
497 -1 -1 -1 -1            8
498 -1 -1 -1    1          9
499 -1 -1    1 -1          9
500 -1 -1    1    1        8
501 -1    1 -1 -1          6
502 -1    1 -1    1        6
503 -1    1    1 -1        3
504 -1    1    1    1        6
505    1 -1 -1 -1            9
506    1 -1 -1    1          9
507    1 -1    1 -1          8
508    1 -1    1    1        8
509    1    1 -1 -1          4
510    1    1 -1    1        8
511    1    1    1 -1        7
512    1    1    1    1        2

Variable codings ...
x1 ~ (Percent.sugar - 10.5)/4.5
x2 ~ (Ratio.yoghurt - 21.85)/14.65
x3 ~ (Percent.kiwi - 11.5)/3.5
x4 ~ (Percent.water - 23.5)/10.5
> design.rs1<-rsm(response~FO(x1,x2,x3,x4)+TWI(x1,x2,x3,x4),data=design.CR)
> summary(design.rs1)

Call:
rsm(formula = response ~ FO(x1, x2, x3, x4) + TWI(x1, x2, x3,
    x4), data = design.CR)

Residuals:
      Min       1Q   Median       3Q      Max
-5.6660 -1.2441  0.1934  1.2891  4.2793

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)    5.81836    0.08024  72.516   <2e-16 ***
```

```
x1           0.01367    0.08024   0.170    0.8648
x2          -0.78711    0.08024  -9.810    <2e-16 ***
x3          -0.20508    0.08024  -2.556    0.0109 *
x4           0.16992    0.08024   2.118    0.0347 *
x1:x2        0.02539    0.08024   0.316    0.7518
x1:x3        0.02930    0.08024   0.365    0.7152
x1:x4       -0.03320    0.08024  -0.414    0.6792
x2:x3        0.11914    0.08024   1.485    0.1382
x2:x4        0.04883    0.08024   0.609    0.5431
x3:x4       -0.13477    0.08024  -1.680    0.0937 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.816 on 501 degrees of freedom
Multiple R-squared: 0.1841,     Adjusted R-squared: 0.1679
F-statistic: 11.31 on 10 and 501 DF,  p-value: < 2.2e-16

Analysis of Variance Table

Response: response
                          Df  Sum Sq Mean Sq F value    Pr(>F)
FO(x1, x2, x3, x4)         4  353.62  88.404 26.8205 < 2e-16
TWI(x1, x2, x3, x4)        6   19.12   3.187  0.9668 0.44704
Residuals                501 1651.37   3.296
Lack of fit                5   48.90   9.780  3.0272 0.01056
Pure error               496 1602.47   3.231

Stationary point of response surface:
       x1        x2        x3        x4
10.431343  7.433978  1.384299  7.318012

Stationary point in original units:
Percent.sugar Ratio.yoghurt  Percent.kiwi Percent.water
     57.44104      130.75778      16.34505      100.33913

Eigenanalysis:
$values
[1]  0.085880192  0.024212241 -0.006822099 -0.103270335

$vectors
            [,1]        [,2]        [,3]        [,4]
[1,] -0.2779165 -0.01975162  0.95851046 -0.06024953
[2,] -0.3948622  0.75854169 -0.06654457  0.51407216
[3,] -0.7164155  0.04625465 -0.24766346 -0.65059371
```

```
[4,]  0.5035823  0.64968060  0.12446817 -0.55572262
```

```
> design.rs1<-rsm(response~FO(x1,x2,x3,x4),data=design.CR)
> summary(design.rs1)
Call:
rsm(formula = response ~ FO(x1, x2, x3, x4), data = design.CR)

Residuals:
     Min       1Q   Median       3Q      Max
-5.6543 -1.1143  0.0332  1.3486  4.3574

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.81836    0.08022  72.530   <2e-16 ***
x1           0.01367    0.08022   0.170   0.8647
x2          -0.78711    0.08022  -9.812   <2e-16 ***
x3          -0.20508    0.08022  -2.556   0.0109 *
x4           0.16992    0.08022   2.118   0.0346 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.815 on 507 degrees of freedom
Multiple R-squared: 0.1747,     Adjusted R-squared: 0.1682
F-statistic: 26.83 on 4 and 507 DF,  p-value: < 2.2e-16

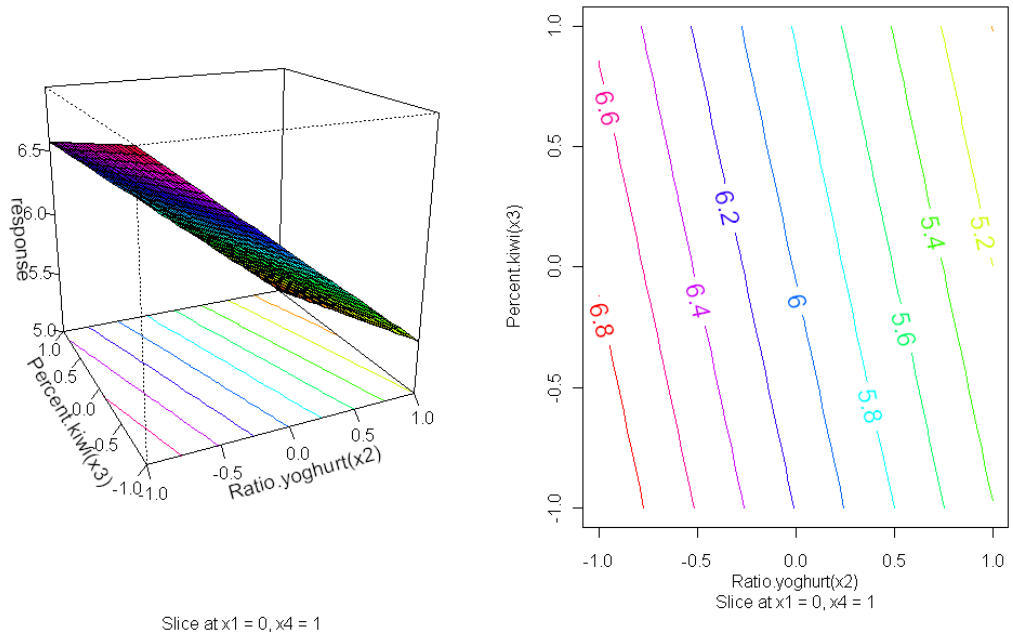
Analysis of Variance Table

Response: response
                Df  Sum Sq Mean Sq F value    Pr(>F)
FO(x1, x2, x3, x4)  4  353.62  88.404  26.831 < 2e-16
Residuals         507 1670.49   3.295
Lack of fit        11   68.02   6.184   1.914 0.03544
Pure error        496 1602.47   3.231

Direction of steepest ascent (at radius 1):
         x1          x2          x3          x4
 0.01645115 -0.94711646 -0.24676732  0.20446435

Corresponding increment in original units:
Percent.sugar Ratio.yoghurt  Percent.kiwi Percent.water
    0.0740302   -13.8752561    -0.8636856     2.1468756
>  par(mfrow=c(1,2))
>persp(design.rs1,~x2+x3,col=rainbow(50),contours="colors",xlab=c("Ratio.yoghurt(x2)","Percent
.kiwi(x3)"),at=list(x4="1"),zlab="response",cex.lab=1.2)
```

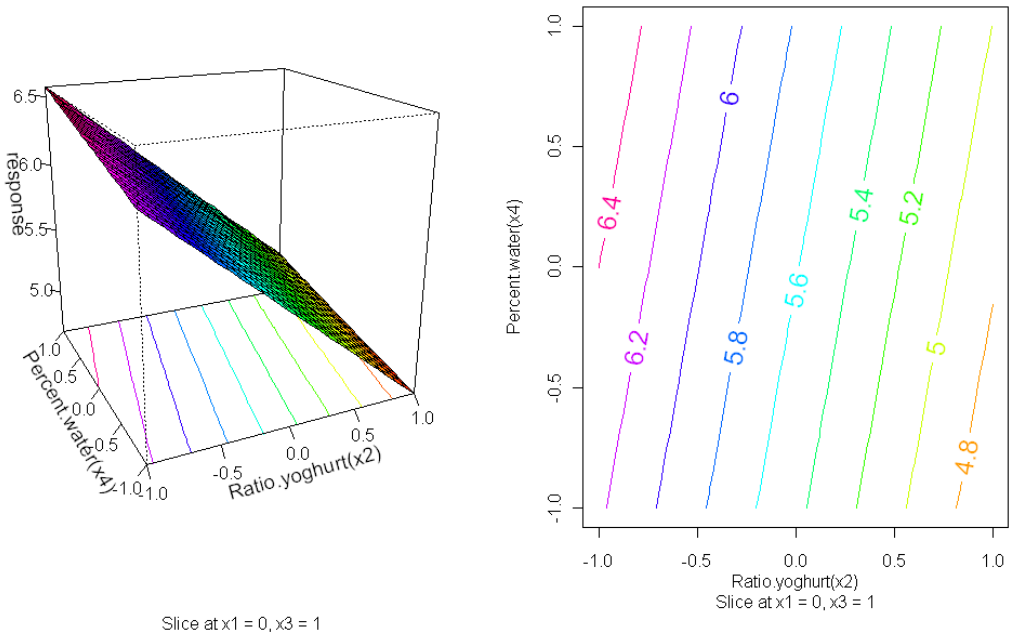
>contour(design.rs1,~x2+x3,col=rainbow(10),xlab=c("Ratio.yoghurt(x2)","Percent.kiwi(x3)"),labcex=1.5,at=list(x4="1"))



> par(mfrow=c(1,2))

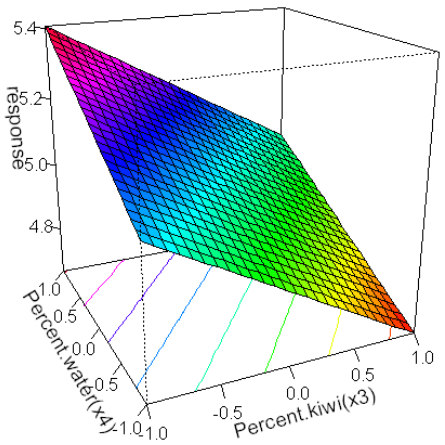
>persp(design.rs1,~x2+x4,col=rainbow(50),contours="colors",xlab=c("Ratio.yoghurt(x2)","Percent.water(x4)"),at=list(x3="1"),zlab="response",cex.lab=1.2)

>contour(design.rs1,~x2+x4,col=rainbow(10),xlab=c("Ratio.yoghurt(x2)","Percent.water(x4)"),labcex=1.5,at=list(x3="1"))



> par(mfrow=c(1,2))

```
>persp(design.rs1,~x3+x4,col=rainbow(50),contours="colors",xlab=c("Percent.kiwi(x3)","Percent.
water(x4)"),at=list(x2="1"),zlab="response",cex.lab=1.2)
>contour(design.rs1,~x3+x4,col=rainbow(10),xlab=c("Percent.kiwi(x3)","Percent.water(x4)"),labce
x=1.5,at=list(x2="1"))
```



Slice at x1 = 0, x2 = 1